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AUTHOR Olson, Arthur V.; Rosen Carl L.
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ABSTRACT

A variety of factor analysis techniques were employed to explore the structure of five reading readiness instruments (Gates Reading Readiness Test, Developmental Tests of Visual Perception, Metropolitan Readiness Tests, Specially Constructed Readiness Test by Olson, Wechsler Intelligence Scale for Children) as predictor variables of performance on the Stanford Achievement Test - Primary I, a commonly-used achievement test in reading at the first grade level. The identification of abilities that might underlie various readiness measures was of particular interest. The six instruments were administered to 218 first grade children representing a stratified sample of the socioeconomic make-up of three elementary schools in a southeastern city of 45,000 people. Four major factors were isolated: Verbal-Conceptual, Auditory-Visual Association, Specific Readiness, and Specific Perceptual Organization. These results are discussed in terms of previous reading readiness research. It is concluded that there continues to be a need for investigations of reading readiness constructs with the goal of further isolating those factors which seem most critical to specific reading behaviors at particular points in the develcpmental sequence. (PR)

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Exploration of The Structure of Selected Reading Readiness Tests

Arthur V. Olson Carl L. Rosen

Georgia State University

Studies concerned with the usefulness of various reading readiness instruments have utilized both crude correlational techniques predicting single reading criterion variables from one predictor variable, or as is more frequently the case today, studies in this area are applying techniques of multiple correlation and multiple regression. Silberberg, Iverson and Silberberg (1) for example, using stepwise linear regression techniques computed prediction equations for assessing the predictive utility of the Gates Reading Readiness tests, Chronological Age, and Stanford-Binet IQ in predicting first-grade reading achievement as measured by the Developmental Reading Tests. Several other studies in this area utilizing such techniques can be found in the literature.

One area that seems as relevant as these problems, is the need for a more satisfactory understanding of the structure of the readiness instruments in such studies. The techniques of Factor Analysis can be used for the purposes of such explorations, which involve the identification of abilities that might underlie various readiness batteries. The isolation of such influences on various combinations of criterion variables could contribute to a more sophisticated understanding of the characteristics being measured by these instruments, as well as their relative conribution to the prediction of reading behavior. The present study explored the structure of five batteries of readiness measures as predictor variables for one commonly used achievement test in reading at the first-grade level.

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Procedure

A battery of five readiness tests and a reading achievement test was administered to 218 first-grade children representing a stratified sample of the socio-economic breakdown in three elementary schools in a city of approximately 45,000 people in the southeast. The battery consisted of (1) Gates Reading Readiness Test (1939), (2) Developmental Tests of Visual Perception (1963), (3) Metropolitan Readiness Tests (1950), (4) Specially Constructed Readiness Test by Olson* (1966), (5) Wechsler Intelligence Scale for Children (1949), and (6) Stanford Achievement Test - Primary I Battery (1964).

The six instruments consisted of 35 sub-test variables which were correlated and the resulting matrices subjected to a principal components analysis employing unities in the main diagonal. The matrix was factor analyzed by the principal axis method to obtain the initial solution. Components whose latent roots were 1.00 or larger were retained and rotated to the varimax criterion following the suggestion of Kaiser (2). A second criteria applied to determine the number of factors to be retained for rotation was based on Cattell's Scree Test (3) involving the examination of eigenvalues. Finally, the psychological meaningfulness of the obtained factor structure following rotations was considered.

Results

For this problem, six factors were extracted with eigenvalues greater than one, accounting for 63.2 percent of the total variance. The Scree Tests suggested a four factor solution, the first four factors accounted for 56.7 percent of the variance. Thus, for interpretive purposes both the six factor and the four

* The Olson Reading Readiness Tests consists of the following sub-tests (1) Auditory Synthesis split-half reliability (r=.80), (2) Identifying Capital Letters Named (r=.94), (3) Identifying Lower Case Letters Named (r=.91), (4) Writing Letters (r=.94), (5) Learning Rate (r=.62), (6) Auditory Discrimination (r=.74).

factor solutions were rotated by the normal varimax procedure in an effort to achieve simple structure.

The rotated factor structure for the six factors revealed four large common factors and two small factors, loading only two variables each. These two factors appeared unimportant and the results supported the indication that a four factor solution was more appropriate. From examination of the rotated factor structure for the four factor solution, it was obvious that the orthogonal varimax rotations did not produce an adequate simple structure. To obtain simple structure it was necessary to rotate by the oblique procedure. The four factors were thus rotated by the maxplane method. Table I shows the hyperplane counts* obtained by the varimax and maxplane methods and the correlations among oblique factors. A study of the intercorrelations among the oblique factors indicated a degree of interdependence between factors I, II and III.

Insert Table I here

Table II presents the rotated factor loadings for the four factors along with their respective reference structure loadings or correlations with the simple axis.

Insert Table II here

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* The number of obtained loadings within a specified range is called the hyperplane width. In this case 0.10 was specified as the hyperplane width.

Factor I: This is clearly a Verbal-Conceptual Factor with three of the WISC subtests saturating the factor; Similarities, Vocabulary and Information. The Stanford Achievement Vocabulary subtest also has a substantial loading on this factor indicating the strong influence of verbal ability on this particular reading achievement subtest. Five additional WISC subtests have substantial to moderate loading on this factor; Picture Arrangement, Block Design, Digit Span, Comprehension and Arithmetic. The Olson subtest Auditory Synthesis has a small loading on this factor as well as WISC Object Assemble, and Paragraph Meaning and Word Reading from the Stanford Achievement tests. It is of interest to note the slight tendency for the reading subtests to load on this factor although the loadings are small.

Factor II: Inspection of the loading pattern suggests that this factor might be called an Auditory-Visual Association Factor. Four of the six subtests of the Olson Readiness Test have major loadings on this factor as well as the subtest Word-Card Matching from the Gates Reading Readiness Test. Of interest is the slight tendency for two Stanford Achievement reading subtests to load in this factor; Paragraph Meaning (.38) and Word Reading (.31).

Factor III: This appears to be a Specific Readiness Factor defined by the WISC Coding, and Information, and Matching and Sentences subtests from the Metropolitan Readiness Test. WISC Picture Completion and Metropolitan Word Meaning subtests have small loadings on this factor which appears to have an audio-visual discrimination influence. This factor seems to be relatively specific to portions of the Metropolitan Readiness Test and WISC and is essentially independent of reading achievement as measured by the Stanford Achievement Test and those aspects of verbal ability measured by the WISC. The slight loading of Frostig subtest Spatial Relations is also of interest.

Factor IV: Inspection of the loading pattern suggests that this clearly is a Specific Perceptual Organization Factor. Visual motor and figure ground subtests have major loadings for this factor. Rhyming, Object Assembly and Position in Space have quite small (.358, .305, .216) loadings. This factor is clearly distinguishable from other perceptual or readiness measures as well as reading achievement as is measured in this study.

Summary and Discussion

Matrices of correlations among 35 subtests from a battery of five readiness tests and a reading achievement test were factored and rotated first to the varimax criterion and then by means of an oblique procedure, rotated by the maxplane method. Four factors were retained for rotation, employing the maxplane method. The four factors are Verbal-Conceptual Ability, Auditory-Visual Association, Specific Readiness, and Specific Perceptual Organization.

The loading pattern in this study indicated a relative degree of interdependence between factors I, II and III. Specific subtests from the Metropolitan Readiness Tests and the Developmental tests of Visual Perception appear to make limited contributions to the prediction of reading achievement as was measured in this study. There was a strong loading of the Vocabulary subtest from the Stanford Achievement test on factor I and very slight loadings of two other reading subtests on this factor. This first factor called Verbal Conceptual ability was saturated with three specific WISC subtests. A second factor, Auditory-Visual Association, which was saturated with four subtests from the Olson Readiness Tests also was noted to have moderate loadings from the Paragraph Reading and Word Reading subtests of the Stanford Achievement tests. A Specific Readiness Factor was identified which was independent of reading achievement as was a fourth factor called Specific Perceptual Organization.

Rosen and Ohnmacht (4) have reported a factor analytic study of first-grade readiness that confirms the limited contribution to predicting reading achievement made by specific subtests of the Developmental Test of Visual Perception and the Metropolitan Readiness Test. This study also replicates the findings of the Rosen, Ohnmacht regarding the suggested lack of construct validity in the Frostig instrument for the construct of Flexibility of Closure. These findings do not support those of Goins (5) and Barrett (6) in which the closure factor as measured by a different perceptual instrument contributed to the prediction of reading.

There seems to be a need for further exploration of the Auditory-Visual-Association Factor identified in this study, which was saturated with four subtests from Olson's Readiness Tests with moderate loading on Paragraph Reading and smaller loading on Word Reading subtests from the Stanford Achievement Test. Performance in such readiness abilities could be related as Barrett (6) has indicated to a whole constellation of environmental experiences or they might also imply intrinsic psycholinguistic facilities of some cruciality to the reading tasks tapped in the above two reading subtests.

There continues to be a need therefore, for investigations designed to explore various reading readiness constructs with the goal of further isolating those factors which seem most critical to specific reading behaviors at particular points in time in the developmental sequence. Postulating some theoretical hierarchy and sequence of such abilities as they differentially contribute at various stages of learning to various finite reading behaviors could eventually have profound implications for some of the practical problems in readiness appraisal and training so common today.

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Table I Factor Intercorrelations and Hyperplane

Count Comparisons for The 35 Sub-Tests

	Factors			
	I	II	III	IV
I	1.000			
II	.716	1.000		
III	.662	.540	1.000	
IV	.395	.375	.485	1.000
Varimax % 17.1		14.3	8.6	11.4
Maxplane% 48.6		51.4	40.0	57.1

Table II Oblique Factor Structure

Factor I - Verbal-Conceptual Ability

Loading	Variable
.713	Similarities (W)
.634	Vocabulary (W)
.626	Information (W)
.560	Vocabulary (ST)
.479	Picture Arrangement (W)
.471	Block Design (W)
.417	Digit Span (W)
.414	Comprehension (W)
.384	Arithmetic (W)
.360	Auditory Syntheses (O)
.341	Object Assembly (W)
.327	Paragraph Meaning (ST)
.313	Word Reading (ST)

Factor II - Auditory-Visual Association

Loading	Variable
.632	Lower Case Letters (O)
.604	Writing Letters (O)
.537	Captial Letters (O)
.426	Learning Rate for Words (O)
.425	Word-Card Matching (G)
.380	Paragraph Meaning (ST)
.362	Vocabulary (W)
.359	Word Matching (G)
.337	Numbers (M)
.320	Copying (M)
.317	Word Reading (ST)
.287	Auditory Discrimination (O)

Factor III - Specific Readiness

Loading	Variable
.535	Coding (W)
.478	Information (M)
.420	Matching (M)
.397	Sentences (M)
.350	Picture Completion (W)
.310	Word Meaning (M)
.285	Picture Directions (G)
.266	Spatial Relations (F)

Factor IV - Specific Perceptual Organization

Loading	Variable
.581	Visual - Motor (F)
.579	Figure Ground (F)
.358	Rhyming (G)
.305	Object Assembly (W)
.216	Position in Space (F)

Code

G= Gates Reading Readiness Test
F= Frostig Developmental Test of Visual Perception
ST = Stanford Achievement Test
M= Metropolitan Readiness Test
O= Olson Reading Readiness Tests
W= WISC